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ABSTRACT

This booklet contains 20 activities designed to make students aware of the intricate linkages between soil, water, and vegetation, and how mismanagement damages the environment. Under this broad theme a wide range of concepts is covered. The activities help develop skills of observation, measurement, data collection, model-making, and creative writing. Information has been provided about the main subject area covered by each activity, the time and equipment needed, the optimum number of students with whom to carry it out, and whether it is an indoor or an outdoor activity. Activity topics include the water cycle, distribution of the Earth's water, weather records, writing about rain, measuring rain, water content in soil, soil erosion, soil salinity, soil permeability, aquifers and wells, flood control, wetlands, and urban flooding. (MDH)

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ED 370 773

FLOODS AND DROUGHT

An educational package

for standards 5 to 8

Centre for Environment Education
Nehru Foundation for Development, Ahmedabad

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This booklet is part of an education package on 'Floods and Drought'.
It includes an 11 panel exhibit and a set of 48 labels.

The package is available in English and Hindi.

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Introduction

Dear teacher,

This booklet is part of an educational package on the theme Floods and Drought. Floods and drought have become a recurring feature in our country. The irregularities of the monsoons are usually blamed for these phenomena. Few of us realize that the increasing frequency and intensity of floods and drought are due to factors other than the monsoons.

An environment degraded by deforestation, mismanagement of soil and water resources, and other human activities becomes increasingly susceptible to the vagaries of weather.

It is therefore essential to create awareness among the people of the relationship between the deterioration of the environment and the increasing incidence of floods and drought. The urgency of better soil and water management and the fact that soil and water can be managed best by ensuring a healthy vegetative cover, have to be emphasized.

This package is an attempt to integrate the various dimensions of this theme in an interesting and informative way. Its emphasis is on protecting the soil, saving water, and greening the Earth. It does not restrict itself to any one discipline but tries to touch upon a number of areas. This package is not exhaustive in terms of content. We have only highlighted some issues and ideas.

The package consists of the following components:

Activity Booklet

This booklet consists of 20 activities which aim at making the students aware of the intricate linkages between soil, water and vegetation and how their mismanagement damages the environment. Under this broad theme a wide range of topics is covered. The activities help develop skills of observation, measurement, data-collection, model-making and creative writing.

You may use the activities in any order you wish. However, it would be practical to do some of the activities in the suggested order as they are based on similar models. For example, activities 8 to 12.

The activities are related to the exhibit panels which form a part of this package. You may use the relevant panel either as a prelude to the activity or to generate a discussion after the activity. All the activities encourage maximum participation by the students.

Information has been provided about the main subject area covered by each activity, the time and equipment needed, the optimum number of students with whom to carry it out, and whether it is an indoor or an outdoor one.

The activities are designed for standards 5 to 8. You are the best judge as to which activities are most suited to your class. You may also want to give them to your colleagues who may be teaching other subjects and other standards.

Each activity is preceded by a note entitled 'Before We Begin'. These notes contain information related to the activity or its theme. You can use the information either as an introduction to the activity or in the discussions after the activity.

Exhibit Panels

The package contains a set of 11 exhibit panels based on the theme Floods and Drought. The panels have been designed for a variety of uses and not just for the classroom. They will be most effective as a small exhibition in the school. (A pamphlet which gives guidelines on setting up a school exhibition is included in the package.) Along with the panels, you can also display some of the models which relate to the themes of the panels. These models can be made by the students while doing the activities of this booklet.

Another way of making the exhibition more participatory is to invite students to prepare paintings, drawings, collages etc., on the theme of the package. These may also be displayed along with the exhibit panels. You could also organize other programmes like debates, role-plays and essay competitions on the theme.

The panels have been numbered and while displaying them, the sequence suggested may be followed to enhance the effect. The panels may also be used individually in any other context that you think is appropriate. One use would be to prepare the class for a particular activity. The panels would serve as a good starting point for a discussion. You will be able to put the panels to many more exciting uses.

We would like the panels to be shown to as large an audience as possible - children as well as adults. We would be very interested to know the response the exhibit panels evoke.

Book Labels

Three sheets of book labels are included. Each sheet contains 16 labels. The visuals on the labels are based on the theme 'Floods and Drought: Act Now'. Each label carries one of the three messages 'Protect Soil'; 'Save Water'; and 'Green the Earth'.

The book labels are to be distributed to the students. Students may be encouraged to write an essay on the caption of their label. In this way each student will have a feeling of being a part of the theme and relate to it with greater enthusiasm and involvement.

We are sure that you and your students will be able to develop many more similar activities and components which are relevant to the conditions specific to your situation. We look forward to your comments on the package.

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1 Before We Begin

Water goes through a never-ending movement from one stage to another. It moves from the oceans to the sky as clouds, falls back to the Earth as rain, and finds its way to the oceans again through rivers and streams. This movement of water is called the water cycle.

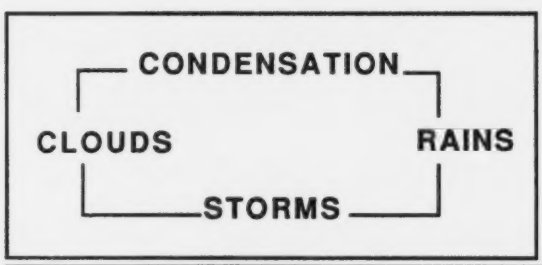
The water in the oceans, lakes and streams evaporates all the time because of heating by the Sun. Water also evaporates from plants. This is called transpiration. The water vapour rises into the air; as it rises, it cools and condenses, and forms little droplets of water that make up the clouds.

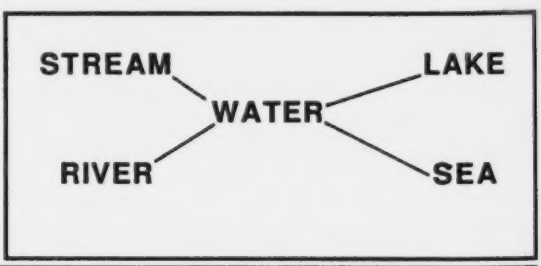
Within the clouds, tiny droplets of water come together to form larger and heavier ones. When the air cools around the cloud, these fall as rain, or, when the temperature is below freezing point, as snow. The water that falls from the clouds - in the form of rain or snow - is called precipitation.

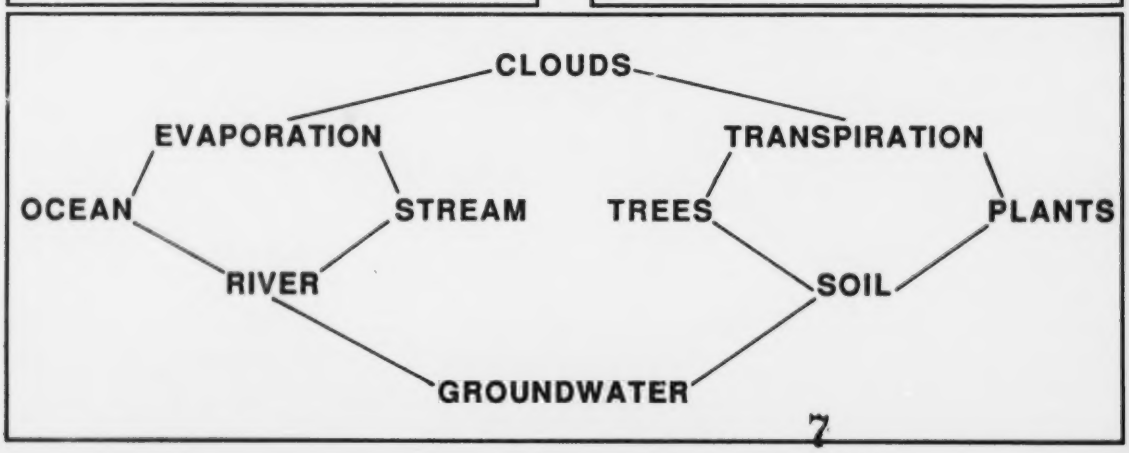
Some of the rain water seeps through the soil and is stored underground. This is called groundwater. Plants absorb water from the soil and return it to the atmosphere during transpiration. Much of the remaining rain water finds its way to rivers and streams which transport it to the oceans. From the oceans it evaporates again. The cycle begins anew.

The branch of science which studies the distribution of water on the Earth and how it circulates from oceans to land and back is called hydrology.

Students are familiar with the water cycle. However, it is interesting to involve the class in an excercise in which students think of the many elements and processes of this cycle and make linkages between them.







An Endless Cycle

1

Subject
Social Studies/Language

Place
Classroom/Outdoors

Group size
Entire class

Duration
45 minutes

Suitable time/season
Any time

Materials
Two plastic bags, half a metre long thread , potted plant.

Objective

To explain the water cycle in a simple and interesting way.

Activity

Pour two spoonfuls of water into a plastic bag and tie its mouth with a piece of thread. Place the bag in the sunlight.

Take a potted plant and cover it with a plastic bag as shown in the figure. Tie the mouth of the bag and place the potted plant in the sunlight. This may be done at the beginning of the day.

Let the students observe the two plastic bags after a couple of hours.

Ask them from where the water droplets in the two bags have come. Are they the result of similar processes ?

Start a discussion on rain. Where does rain come from? What happens to the rain water when it reaches the Earth?

Introduce the topic of the water cycle.

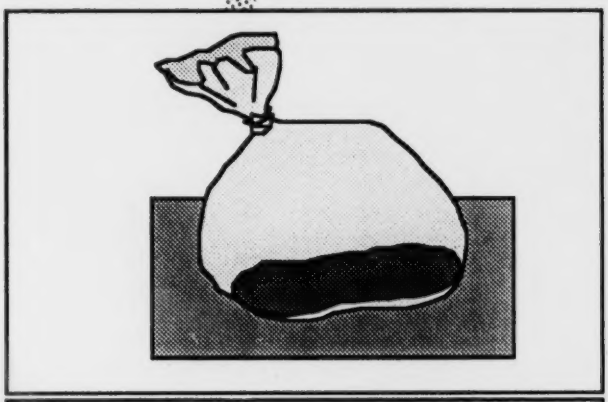
List down on the blackboard all the words related to the water cycle that come up during the discussion. Continue the discussion till you have 20-25 words in your list.

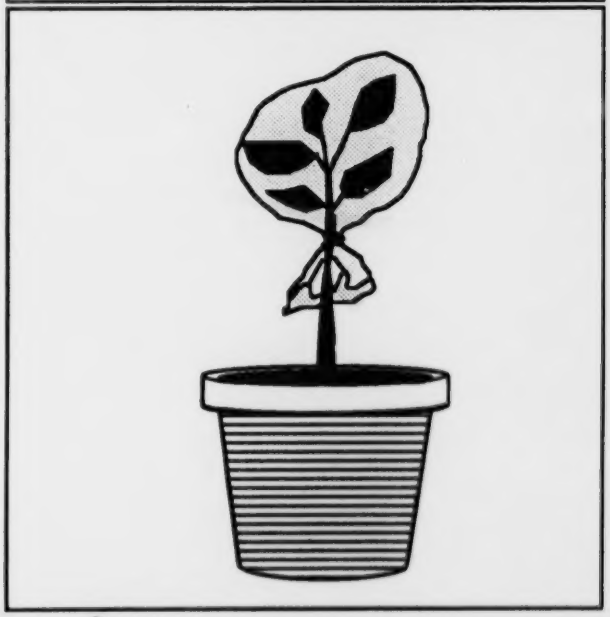
Ask the students to form simple word links. To do this, let them select some words out of the list and link them together. Some examples are given on the facing page.

Prepare several word links like these and ask the students to link them together to get a more complete picture of the water cycle.

Variation/extension

Divide the class into groups. Ask each group to contribute an illustration on a part of the water cycle. Put these together to form the complete water cycle.





2 Before We Begin

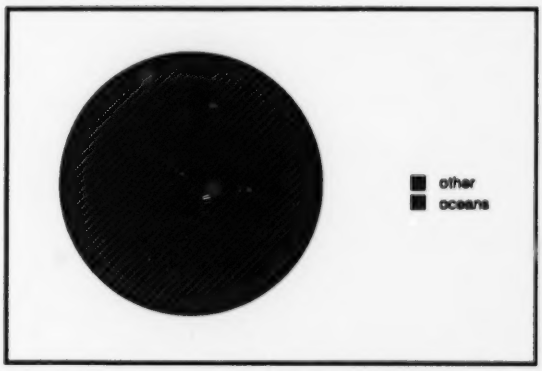
When we use water for our daily activities we hardly pause to think that we are using a very precious resource. The world's water resource seems enormous. Nearly three - fourths of the Earth's surface is covered by water. However, not all of it is available to us.

The oceans contain 97 per cent of the water, but all this is salty. The glaciers and ice-caps make up two per cent. Less than one per cent is the fresh and usable water of lakes, ponds and rivers, and groundwater.

The precious supply of fresh water is continually replenished by rain. Rivers, lakes and wells would go dry, crops would wither and all life would come to an end without this replenishment.

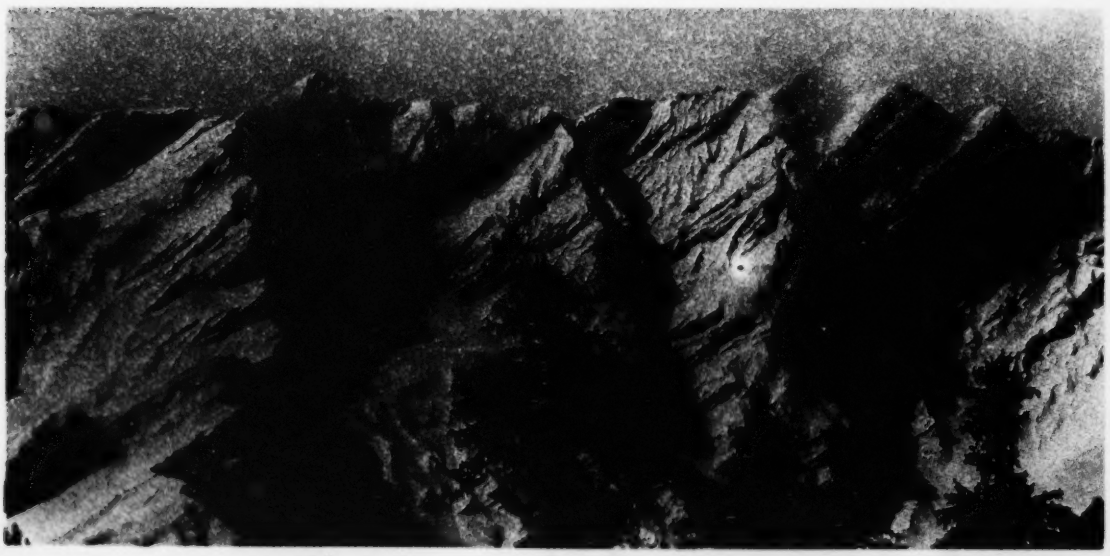
The following table gives the percentage distribution of water on the Earth.

Oceans	97.2
Ice-caps	02.0
Groundwater	00.62
Fresh water lakes	00.009
Inland seas and salt lakes	00.008
Atmosphere	00.001
Rivers	00.0001
Total	99.8381



Based on these percentages, the following activity demonstrates in a simple but effective way this distribution.

Students may be surprised to see how small is the quantity of water available for our use.



A Drop of Water

2

Objective

To demonstrate to students the distribution of water on Earth.

Activity

Divide the class into small groups. Ask each group to measure 2200 ml of water in a container. If a measuring cylinder is not available, a soda water bottle which has a capacity of 200 ml may be used.

Tell them to assume that 2200 ml represents the total water available on Earth.

Ask them to take a teaspoon and measure out 12 spoonfuls of water into a smaller transparent container. Tell them that this is the total amount of fresh water on the Earth, including the water found in lakes, rivers and ice-caps, and as groundwater.

The water that remains in the large container represents salty water found in oceans and seas.

From the container with 12 spoonfuls of water, let the students measure out two spoonfuls into a dish. This represents the groundwater.

Let the students take another dish and remove into it half a spoon of water from the container now having 10 spoonfuls of water. This represents the water found on the surface of the Earth in fresh water lakes.

From the remaining water in the smaller container, let the students remove one drop using an ink-dropper. This drop represents the amount of water to be found in rivers.

The smaller container will now have about nine spoonfuls of water left in it. Tell the students that this represents the amount stored in ice-caps.

Ask the students to compare the quantities of water in the various containers.

Evaluation

Ask the students why the fresh water stored in ice-caps is not readily available to us.

Subject
Social Studies

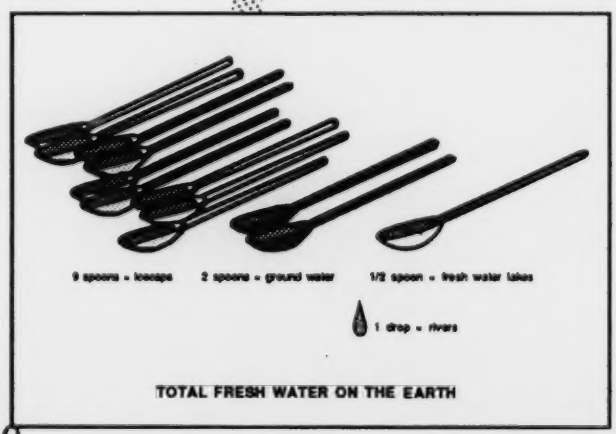
Place
Classroom

Group size
9 - 10

Duration
45 minutes

Suitable time/season
Any time

Materials
Large container (2.5 litre capacity), small transparent container, two small dishes and one dripper.



TOTAL FRESH WATER ON THE EARTH

3 Before We Begin

People have always scanned the skies for clues to the weather. Farmers and fishermen have, through the ages, learned to read the clouds and winds and predict what the weather will bring. Today we have people who specialize in the study of the weather. They are called meteorologists.

The study and interpretation of weather is done on a world-wide scale. From thousands of weather stations located all over the world, both on land and sea, the weather is monitored at least four times a day. Measurements are taken of such variables as temperature, pressure, wind velocity, cloud cover, and precipitation. There are also many un-manned weather stations in polar regions, deserts or other places where few people live. The weather of the upper atmosphere is monitored by balloons and satellites which send photographs regularly to the Earth.

The information collected by weather stations, balloons and satellites is analysed by meteorologists. This information is then conveyed to the public through newspapers, radio and television.

We cannot forecast weather with absolute accuracy but warnings of cyclones or storms which lead to floods can be given sufficiently in advance by studying weather information. By keeping records of fluctuations in the weather pattern, it is possible to predict and hence plan for periods of shortage or excess of water.

While it will be difficult for students to accurately measure weather, they can collect and study the data already collected by meteorological stations in the country.

The following activity would involve the entire class in maintaining a daily record of the weather and in interpreting the record for their area.

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Weather Watch

3

Objective

To develop in students an interest in maintaining weather records.

Activity

Ask the students to obtain data on temperature, humidity and rainfall for each day from the newspapers. The students may take turns to collect this data.

Let them display this information in the form of a chart. An outline of such a chart is given below. The students may prepare a similar one for their purpose.

After one month, ask them to calculate the average rainfall, humidity and temperature for the month. After a few months they may plot graphs of some of these variables to get a clearer picture of how these changes take place over a period of time.

Subject
Social Studies/ Maths

Place
Classroom

Group size
Entire class

Duration
10 minutes every day over a period of one month.

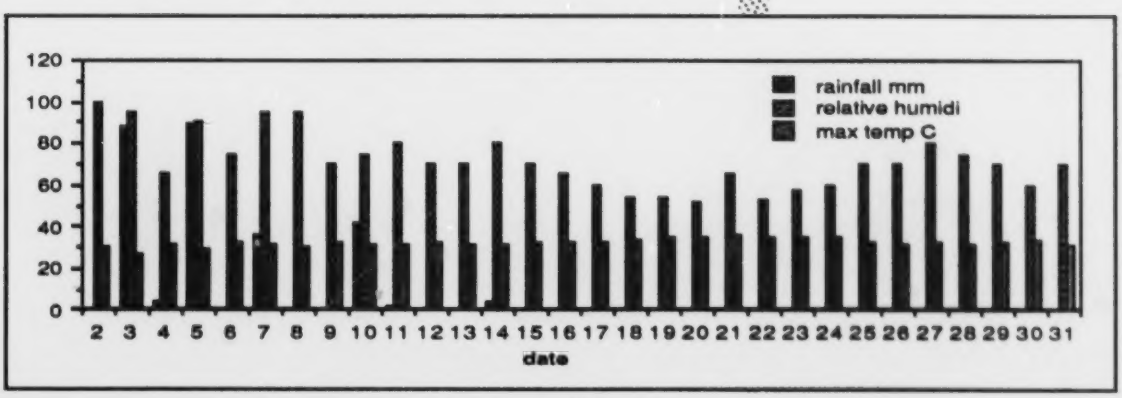
Suitable time/season
Preferably during the monsoon.

Materials
Newspapers, chart paper, graph paper, scale, pencils.

DATES		1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 ...31	AVERAGE
JAN	RAINFALL		
	TEMP.		
	HUMIDITY		
FEB	RAINFALL		
	TEMP.		
	HUMIDITY		

Variation/extension

- Ask the students to exchange weather data with different schools in India.
- Encourage them to form a Weather Watchers' Club.
- They may make 'weather pals' from different regions and exchange weather information with them.
- Take them on a visit to the nearest meteorological station.



4 Before We Begin

India receives most of her rainfall during the monsoon months - June to September - due to seasonal winds and the temperature differences between land and sea. These winds blow from opposite directions in different seasons. They blow into India from the surrounding oceans during the summer, and blow out from the Indian subcontinent to the oceans during winter.

The distribution of rainfall over India during the south-west or summer monsoon depends largely on the orographical features - the position of hills and mountains. Take the case of the Western Ghats, where heavy rains of upto 200 cm annually fall on the windward side (Bombay, Kerala) while the leeward side (Pune, Tamil Nadu) receives only 60-75 cm during the same period. The geographical distance between the two might not be much. (Bombay and Pune are only 160 km apart.)

Some of the world's heaviest rainfall occurs where moist sea air cools as it rises to cross mountain ranges. This is called orographic rain. The most well known example of this is Cherrapunji in north-east India. This small town in Assam records an annual rainfall of about 1,100 cm.

The monsoon in India, while being reasonably stable seasonally, is geographically variable. That is, while India may have a good monsoon on an average, there may be wide fluctuations locally. The commencement of the rain may be considerably delayed over the whole or a large part of India. The rains may terminate earlier than usual. They may be heavier than usual over one part than over another. All these may cause local floods or drought.

Even regions which receive adequate rainfall during the monsoon suffer during the pre-monsoon months of January to June due to the lack of storage facilities.

The rain plays a decisive role in the lives of Indians. Lives of plants and animals are also governed by rain. After eight months of heat and dust and water shortage, the monsoon comes as a blessing. The land is watered, the spirit revived in all living things, and as a poet has put it, "Heat dies in the appeasing rain".

Literature in all Indian languages has dwelt on the joy that the monsoon brings. In the following activity students express their thoughts and feelings about rain, floods or drought in the form of poems.

4

Subject
Science/Social Studies/ Language

Place
Classroom

Group size
Individual

Duration
30 minutes

Suitable time/season
Any time

Materials
Writing materials

Objective

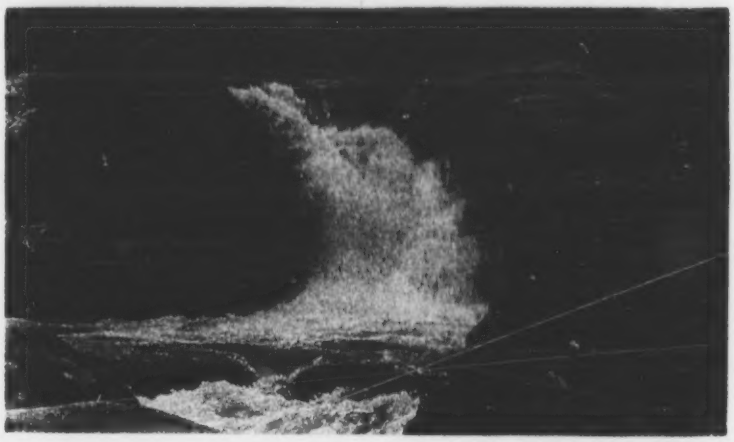
To encourage students to compose small poems on rain, floods and drought.

Activity

Ask each student to choose an object in nature or a theme like the Sun, soil, air, cloud, tree, grass, water, river, etc. related to rain.
Let them take up paper and pencil and
1. On the first line write the name of the object or theme (subject/noun);
2. On the second line write two words describing the qualities of the object or theme (adjectives);
3. On the third line write three words of action about the object or theme (verbs);
4. On the fourth line write four words describing how they feel about the object or theme (phrase, sentence, expression)
5. On the fifth and last line write a word to replace the title (synonym).
Now let them read it like a poem. Here are a few examples.

Flood
Rushing, roaring
Uprooting, destroying, spreading
A phenomenon causing havoc
Fearful

Thunder
Rolling, crashing
Rumbles, roars , rattles
Sound of battle drums
Music



Variation/extension

Ask the students to find some poems on rain and some stories about floods and drought. They can also ask their parents or grandparents to relate local legends and beliefs about rain, floods or drought.

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5 Before We Begin

It is said that in India it never rains but it pours. Taken as a whole, the country receives abundant rainfall. On an average, the plains receive more than 117 cm of rain, which is the highest in the world for an area the size of India. (A centimetre of rainfall, if collected on a level surface which will not absorb the water, will form a sheet of water one centimetre thick.)

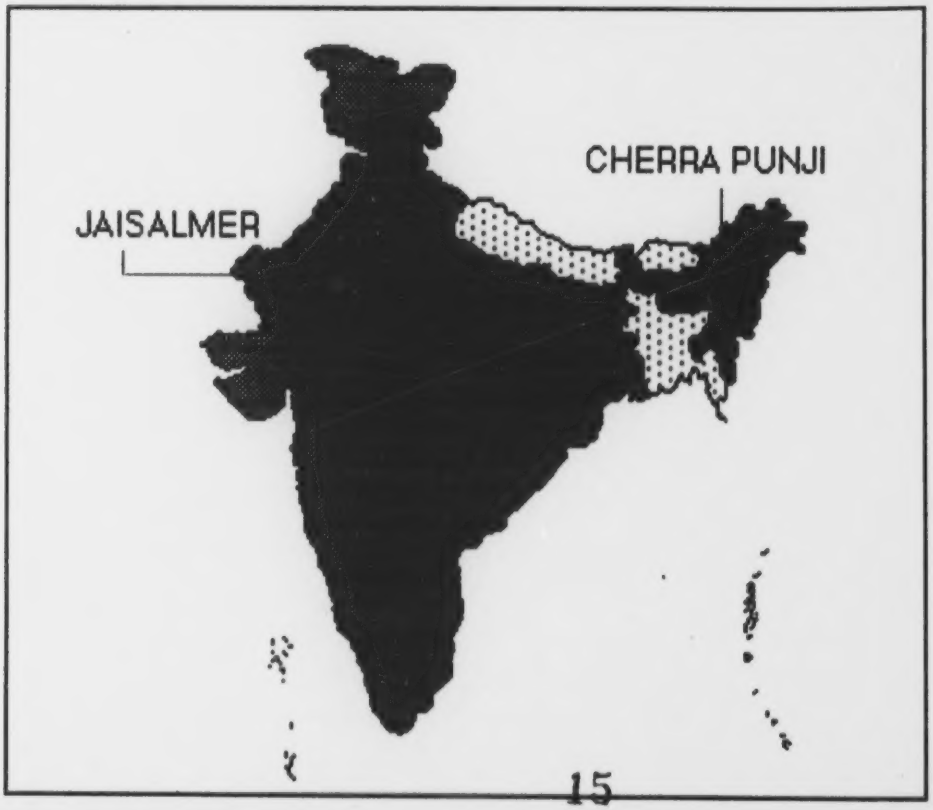
But the Indian rainfall is unevenly distributed over the country. Cherrapunji in the east annually receives 1140 cm of rain, and occasionally as much as 100 cm a day. Jaisalmer in west Rajasthan receives only 21 cm. Between these two extremes there is a wide variation. There is also a great variation in the amount of rain falling from year to year in the same place.

These extremes may lead to floods and drought.

It is therefore essential to understand the patterns of rainfall. Meteorologists using accurate instruments study weather conditions over the years and their records help in analyzing the patterns of rainfall.

Rain gauge is an instrument with which rainfall is measured. In the following activity, students make a rain gauge from commonly available objects. They can be encouraged to use it to measure the rainfall in their areas.

A discussion on how information about rainfall is useful to various people like farmers, pilots, and seamen can be carried out along with the activity.



Measuring Rain

5

Objective

To introduce students to one of the methods of measuring rain.

Activity

Ask students to bring a funnel and a cylindrical tin can or bottle of known volume from their homes. The diameter of the container and that of the wider end of the funnel should be the same.

Now , ask the students to find an open area. Such an area could be their playground or some other area near their home or school. The area should be more or less level.

Ask the students to keep their tins or bottles on the area chosen by them and place the funnel in it before it begins to rain. They must ensure that the container is not disturbed during the period of the rain and is not toppled over by the wind. It would be a good idea to sink the container a few centimetres into the ground.

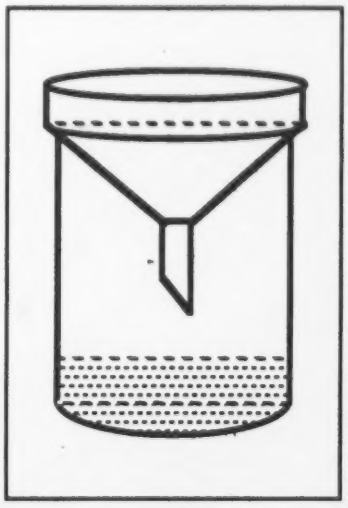
After the rain let them collect their containers carefully without spilling the water in it. They should now keep the container on a level surface and, using a metre scale, measure the depth of the water that has collected.

If the mouth of the bottle is too narrow for a scale to be put in, a stick may be used. The wet part of the stick may be measured and this may be related to the volume of rainfall.

Extension

Ask them to compare results with other students. They may also compare their readings with what is recorded at a nearby meteorological station. They can get this information from the next day's newspaper or from the weather bulletins of radio and TV.

The students may similarly measure the amount of rainfall after every rain for one year and compute the annual rainfall for their area.



Subject
Science/Social Studies

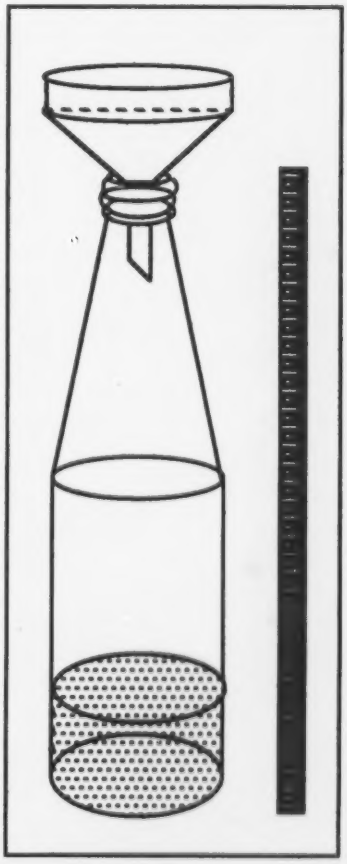
Place
Outdoors

Group size
Individual

Duration
Over a twenty-four hour period of rain.

Suitable time/season
Rainy season

Materials
A cylindrical tin can or a bottle of any size, with a narrow neck; a funnel, its diameter equalling the base of the container; a wooden scale or a stick.



6 Before We Begin

The rain water that falls on the ground moves in two ways. Some of it flows over the surface and finds its way to streams, rivers and lakes. This surface flow of water from one location to another is called run off.

Some of the rain water seeps down through the soil and is stored as groundwater.

Both these movements of water are very important as in both cases, the rain water moves towards a point where it can be stored and can be used at a later period when there are no rains. The land area that contributes run off to a particular body of water is called a watershed.

Run off waters are necessary to renew many aquatic habitats that are dependent on the inflow of water for their continuity. They prevent lakes from drying up due to evaporation and prevent streams from going below minimum flow levels.

Run off is a resource that can be utilised by humans for agricultural development, for power or transportation or for increased domestic use; but only if it is not rendered unfit through human misuse. It is in run off that many pollutants such as pesticides, sewage, and industrial waste are washed into lakes, ponds and streams. Run off may also be responsible for erosion of the soil and transportation of silt. This silt gets deposited in rivers and reservoirs, increasing the possibility of flooding.

In this activity the students calculate both the volume and the weight of the rainfall over a particular area. The actual area of the school ground or any other site can be measured. The rainfall can be actually measured by placing a rain gauge on the site. The date may also be taken from the newspaper. The calculated area, multiplied by the height of the rainfall, would give the volume of the rainwater in the site under study.

An important aspect of the activity is for the students to realize the immense amount of rainwater over a known area. Where would all this water go? This would be an interesting point to start a discussion. You can explain how some of the rainwater would flow laterally as runoff water, some of which would be absorbed by plants and some would collect in lakes and rivers, to be used by all life on Earth. Some would infiltrate vertically downwards, to be stored as groundwater.

The students can relate the total amount of rain water to the shortage of water during dry periods which make natural water storage systems so essential prevent shortages of water during the eight months following monsoons, to preventing the effects of drought.

Pace Measuring

6

Subject
Social Studies

Place
Outdoors

Group size
Entire class

Duration
Any time

Suitable time/season
Any time, preferably during the monsoon

Materials
Paper and pen

Objective :

To demonstrate a method to calculate the volume and the weight of rainfall in a given area.

Activity:

Select a rectangular site. Ask the students to pace-measure the length and breadth of the site as explained below. A pace is the length of one full stride, as shown in the diagram.

Divide the students into four groups.

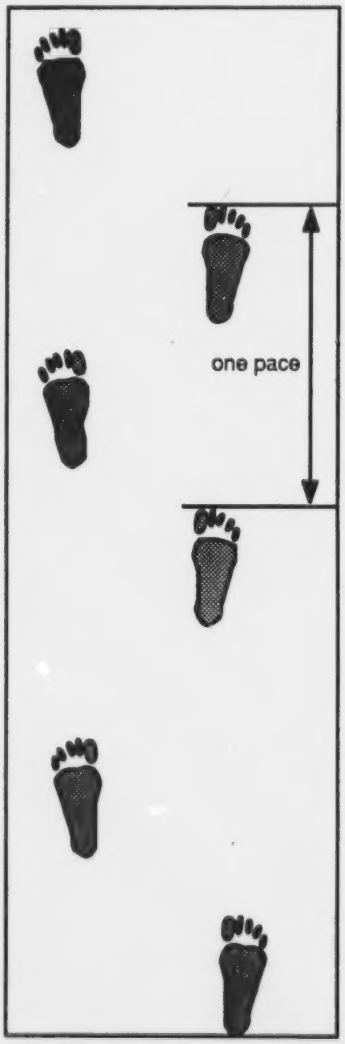
To determine the length of one pace, let one student in each group walk five paces. Measure the total length of the five paces and divide by five. This provides the average pace length for the group.

Let one student in each group pace-measure the length and breadth of the activity site. Let them multiply the length of one pace by the number of paces in the length and breadth respectively. Now ask the students to calculate the area of the entire activity site.
Area = Length x Breadth

An example is given below:

If the length equals 110 paces and one pace equals one metre, then the length is equal to 110 metres. If the breadth equals 72 paces, then the breadth equals 72 metres.
Area = 110 x 72 = 7,920 square metres

Now, let the students calculate the volume of rainfall if 30 cm fell on the site.
Area (in square metres) x 0.3 m. = Cubic metres of rainfall.
Thus 30 cm of rainfall equals
7,920 x 0.3 m = 2,376 m^3
Now, to calculate the weight of all the water
If 1 m^3 = 1,000 Kg
2,376 m^3 = 2,376,000 Kg
Thus, an area of 7,920 square metres receiving an annual rainfall of 30 cm gets 2,376,000 Kg of water. Some of which runs off laterally as surface water and some percolates vertically downwards to collect as groundwater.



Evaluation:

Discuss the probable distribution of rainwater that fell on the

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area measured by the students. Which parts of the ground promoted run off? Which parts allowed absorption? Why? Were there any places on the ground where water flowed off more freely than other places - that is can they discover a 'watershed' on the school ground? Where does all this run off go? If possible trace the water from the school ground to the nearest water shed which might be affected by this run off either positively, negatively or both.
Discuss how runoff contributes to loss of topsoil and excessive sedimentation.

Variation/extension:

Place a rain gauge on the school ground and measure actual amounts of rain fall.Calculate the amount of water the school ground receives.
Using the district map, calculate the area of the city and the total amount of rain during the four months June to September.

7 Before We Begin

Groundwater is very important to plant, animal and man. Thus the ability of the soil to absorb and allow infiltration of water is very important.

The movement and retention of water in the soil is related to the size, shape, continuity, and arrangement of the pores in the soil, their moisture content, and the surface area of the soil particles.

Some water is held in the soil pores by the forces of adhesion (the attraction of solid sufaces to water molecules) and cohesion (the attraction of water molecules to each other).

These forces keep the smaller pores full of water and maintain relatively thick films on the walls of many larger pores. The water in the soil moves downwards if the soil is dry and unsaturated. Not until the pores in one layer of soil are filled with all the water they can hold, does water move down to the layer below . Hard, impermeable rock prevents the movement of water or changes its direction, forming the base of the water table.

Water is found in the soil in both the vapour and liquid state. The air in all the soil pores (except those on the surface or a few centimetres below it in very hot, dry soils) is saturated with water vapour.

The maximum retentive capacity is the moisture content of a soil when all of its pores are filled or saturated with water.

The moisture in the soil also determines plant growth. The soil moisture available for plant use varies with different types of soil. Loamy soil, which is a mixture of sand, clay and mud, retains water in a way that is most useful for growth of vegetation. Sandy soil is unable to retain water as the pores are very large and the rate of evaporation is high. Clayey soil retains too much water and does not let it permeate to lower levels, leading to water-logging of the soil in which the roots of plants tend to rot.

The roots of plants help in absorption of rain water in the soil and the vegetation prevents excess evaporation of the water from the soil, thus maintaining the soil-water balance and recharging groundwater. Having become aware of the importance of soil moisture, the students would be interested in seeing for themselves that soil contains water. The following activity is a simple way to demonstrate this.

Water in the Soil

7

Subject
Science/Social Studies

Place
Classroom/Laboratory

Group size
Four

Duration
45 minutes

Suitable time/season
Any time

Materials
Large tin with lid, weighing scale; stove; soil

Objective

To demonstrate the fact that soil contains water.

Activity

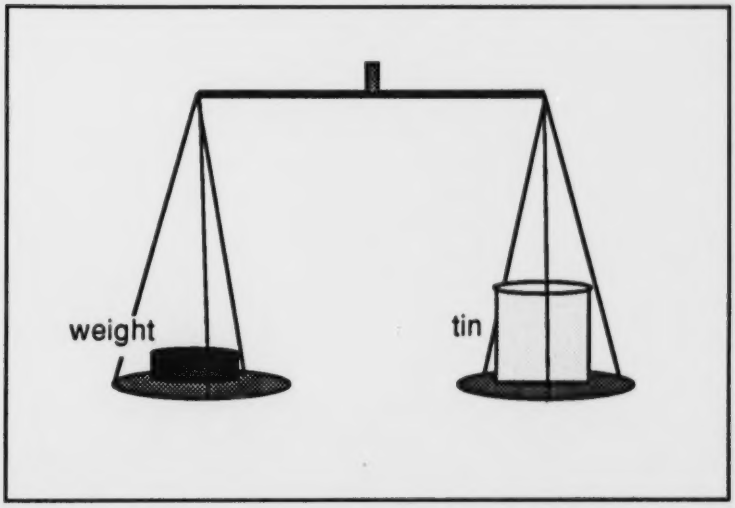
Divide the students into groups.Ask each group to bring one empty tin which has a lid.
Ask the students to collect 100 gm of soil and put it into a tin. The soil should be spread out evenly on the bottom of the tin.

Let them weigh the tin with the soil and note the weight.
Then ask them to cover the tin loosely with its lid and heat it over a medium flame for two minutes.
Let them remove the lid and observe the inside of the tin.
What do they see?
Where does this water come from?
Now , instruct the students to heat the tin again for five minutes, without the lid.

Let it cool. Now, let them weigh the tin with the soil
Does it weigh more or less than before? Why?

Variation/extension

Ask the students to collect some soil in a tin . Cover the tin firmly with the lid and leave it on its side in the sun for some time.
Later, touch the inside surface of the tin. Which part of the tin is damp? Why? Where did the water come from?



8 Before We Begin

Soil is a vital resource. Yet every day we are losing it. One of the causes of this loss is erosion or the wearing away of the Earth's surface. Erosion is a natural process, but the activities of man hasten and make it more severe.

The kind and degree of erosion depend, to some extent, on the texture and structure of the soil, climate, nature of vegetation, cultivation and other factors. Running water on barren lands is the most important cause of erosion.

Erosion by water can take place in two ways - gully erosion and sheet erosion. Gully erosion generally occurs on steep slopes where there is no vegetative cover to arrest the flow of rain water. The water cuts channels into the land and carries away soil with it.

Sheet erosion is the removal of a thin layer of soil, more or less uniformly, from the entire surface of an area devoid of vegetation or lacking vegetative cover. The rain water that the ground does not absorb runs off the surface, carrying top soil with it. After a prolonged dry period the soil surface may become very hard and may temporarily lose its capacity to absorb water. A sudden heavy fall of rain can then cause sheet erosion.

When wind blows over land on which there is no vegetative cover, it blows away the top soil. This happens more in arid and semi-arid areas. Strong winds often carry fine dust particles for hundreds or even thousands of kilometres.

Soil erosion degrades the soil, making it unfit for cultivation and reduces the seepage of water through the ground. This may lead to drought. The soil that is washed away gets deposited in river beds, reservoirs, tanks, and ponds, raising their level and reducing their capacity to hold water. This may result in the greater frequency and intensity of floods.

In the following activity, students see the effect that wind and water have on unprotected soil.

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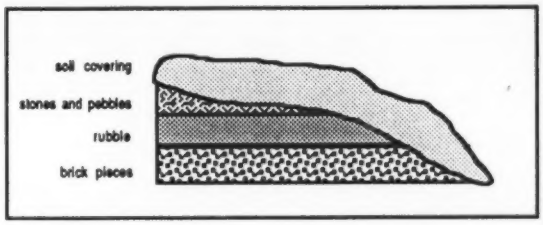
Wind and Water

8

Objective

To enable students to understand that wind and water are two factors that cause soil erosion.

Activity

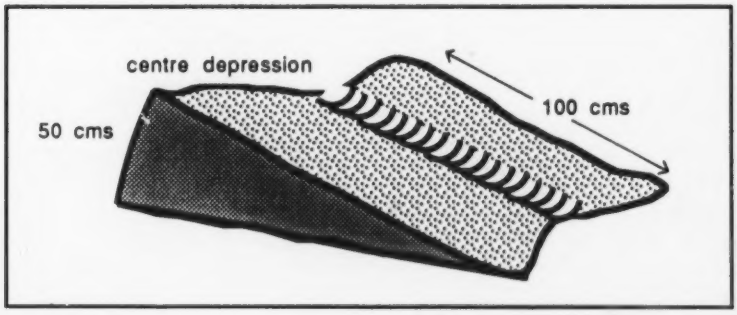


Ask the students to prepare three slopes as decribed below.
The height of each slope may be 50 cm and the length of the ridge 100-150 cm, with a gentle slope on one face (see fig).

The slopes can be prepared by first piling up brick pieces, followed by a layer of rubble and a layer of stones. Each layer can be about 10 to 15 cm in thickness.

Cover the first slope with a layer of sandy soil 6-8 cm thick..
Cover the second slope with 6 to 8 cm of ordinary soil (a mixture of sand and clay).
Cover the third slope with a layer of manured soil.

Pack the soil in such a way that the edges of the slopes are slightly higher than the middle portions so that water poured would flow along the slopes and not off the edges.



The second and third slopes will be used for activities 9-12.

With the help of the blowpipe, bellows or hand fan pass a gentle stream of air over the slope covered by the sandy soil. Now pass a stronger stream of air over the slope.

Repeat with the slope covered by ordinary soil. Let the students observe carefully the effect produced by the wind on

Subject
Social Studies

Place
Outdoors

Group size
Entire class

Duration
Two hours for preparing the model. 45 minutes for the activity.

Suitable time/season
When it is not raining

Materials
Bricks, rubble, stones, sandy soil, ordinary soil, manured soil, two tin cans of two litre capacity, one with small perforations and one with large perforation, blow pipe, hand fan or bellows.

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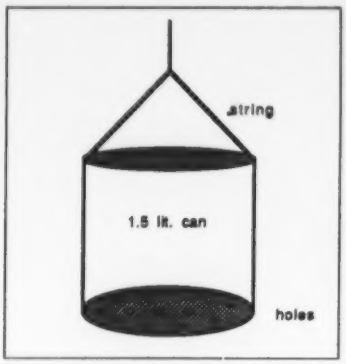
the two slopes. Explain how soil erosion takes place and how wind is responsible for it.



Now pour equal amounts of water through the finely perforated tin can on the two slopes. Repeat with the other can having larger perforations. Let the students observe the effect in each case on the two slopes.

Ask the students to relate the effect of rainfall on different types of soil and the damage caused by the intensity of rainfall.

Variation/extension

1. Instead of the slopes, the students can use trays which are kept in a slanted position and filled with the two types of soil.

2. Take the students on a walk after a rainy day and show them the different types of erosion caused by the rain water. Let the students prepare sketches of their observations and put them up in the classroom under the title "Effects of Water Erosion".

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9 Before We Begin

Rain is the main source of water in India. After it rains, some of the water evaporates, some of it percolates into the ground to be stored as groundwater and the rest flows into rivers and streams. How much of the water flows over the land immediately after the rain and how much sinks into the ground determines to a great extent the incidence and intensity of floods and drought.

Nature provides one of the best ways of controlling floods and drought in the form of vegetation. Any vegetative cover, whether it is a mere blade of grass or a big forest, helps to slow the water running off the land. This acts as a check on soil erosion.

The canopy of vegetation, by absorbing the impact of raindrops, minimises the destructive effects of the beating action of rain on soil. The roots of plants hold the soil together and prevent it from being washed away.They also keep the soil porous, helping the rain water to percolate into the soil. Land without vegetation becomes hard and this increases run off and soil erosion.

Forests provide decaying organic matter or humus which forms a protective layer over the soil, and reduces the impact of raindrops. It also absorbs water and allows it to enter the soil to be stored as groundwater.

In the earlier activity students observed how soil without vegetative cover is affected by water and wind. The following activity demonstrates how vegetation protects soil from being washed or blown away.

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Controlling Cover

9

Subject
Social Studies

Place
Outdoors

Group size
Entire class

Duration
Two weeks to prepare the model. 30 minutes for the activity.

Suitable time/season
When it is not raining

Materials
Bricks, rubble, stones, ordinary soil, manured soil, mustard seeds, two perforated tin cans (1.5 litre capacity each) one with large perforations and the other with small perforations.

Objective

To demonstrate the importance of vegetation in controlling soil erosion.

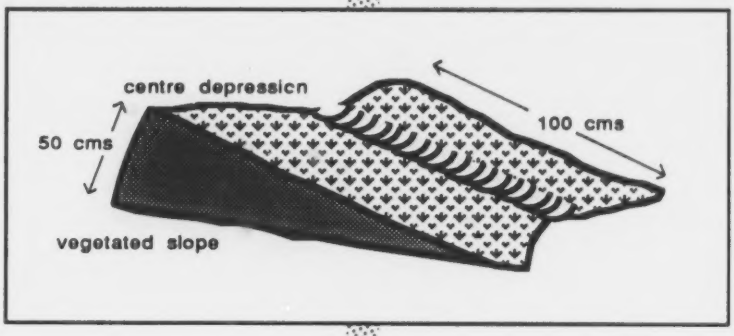
Activity

Prepare two slopes as in the previous activity (Wind and Water), one covered with manured soil and the other with ordinary soil.

On the first slope sow mustard seeds or any quick-growing grass and water regularly till the plants are about 8-10 cm tall. Leave the second slope bare.

Pour water on the two slopes, using the tin can with small perforations to show the effect of rainfall. Use equal amounts of water on each slope.

Now water the two slopes, using the tin can with larger perforations to show the effect of heavy rainfall. Use equal amounts of water on the two slopes. Let the students observe and compare what happens in each case.



Variation/extension:

Take students to an area with a lot of vegetation and one with very little. Let them find out how vegetation, or the absence of it, has had an impact on soil conditions.

Evaluation

Start a discussion on rainfall as a cause of soil erosion. How does vegetation affect the rate at which water moves down a hill? What is the role of each part of a plant in holding back rain water? What effect does the intensity of rainfall have on soil erosion?

Compare the two slopes to natural conditions and discuss the role of vegetation, especially forests and the decaying organic layer (humus), in controlling soil erosion and retaining rain water.

10 Before We Begin

Most rivers start as small streams high in the mountains. When many streams join together, the volume of water carried by them increases, and their combined flow is called a river.

The land area which drains into a particular river is called its watershed. The surface run off from this land area ultimately finds its way to the river.

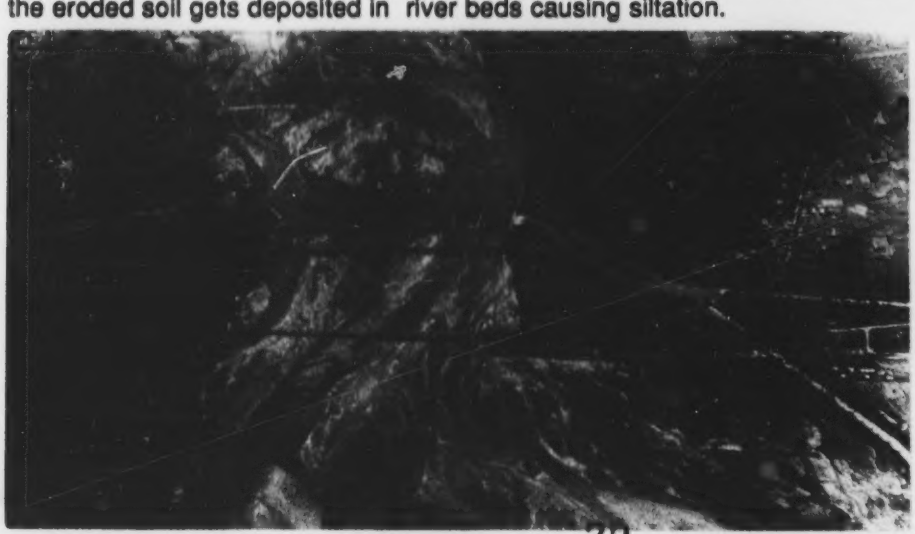
When the watershed of a river is heavily forested, the surface run off after rain is considerably less. Tree-roots soak up some of the rainfall, and the thick mat of dead plant material on the forest floor absorbs large quantities of water. The roots of trees also prevent soil erosion.

In contrast, in deforested areas, the run off from the watershed is considerable. This water also carries with it large amounts of soil which has been eroded from the barren, tree-less land. Hence, during heavy rains, the volume of water carried by rivers in deforested areas is very large.

The water also carries with it large quantities of silt which accumulates on the river bed, raising its level. This reduces the water-holding capacity of the river channel. The lesser the water the river channel can hold, the greater the chances of the river overflowing its banks and flooding the surrounding areas. To contain the river water, embankments are often constructed along the river. But when the level of the river bed rises, these become ineffective very quickly. Moreover, the danger of the river breaching the embankements becomes serious, and this could result in disastrous floods.

Reservoirs of dams also face danger from siltation. The silt carried by the river settles down in the dam reservoir. These gradually fill up. The same happens to tanks, ponds and lakes. This ultimately reduces their storage capacity, which can have serious consequences in times of scarcity. Community effort to prevent siltation of tanks, ponds and rivers, and to de-silt those that have silted up is of vital importance and should be taken up in non-monsoon months.

In the earlier activities, the students had observed how soil is eroded and how vegetation helps to lessen this. In the following activity they will observe how the eroded soil gets deposited in river beds causing siltation.



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Mounting Danger

10

Subject
Social Studies

Place
Outdoors

Group size
Entire class

Duration
Two weeks to prepare the model. 30 minutes for the activity

Suitable time/season
When it is not raining

Materials
Bricks, stones, pebbles, rubble, ordinary soil, manured soil, mustard seeds, one perforated can (1.5 litre capacity), with small perforations, digging implements.

Objective

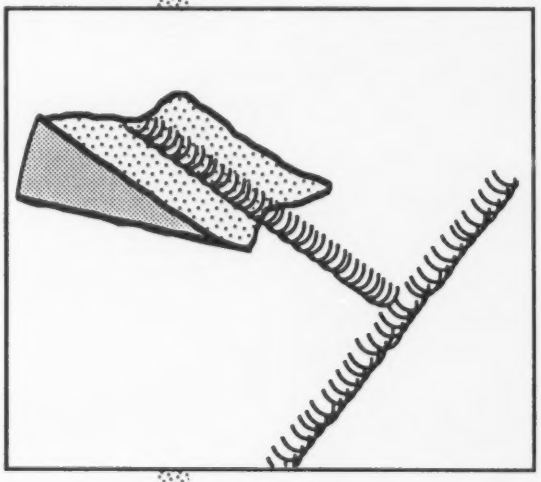
To demonstrate how soil erosion leads to siltation of river beds causing them to overflow.

Activity

Let the students prepare two slopes as in the activity "Wind and Water", one of them covered with manured soil and the other with ordinary soil. On the first slope plant mustard seeds or some quick-growing grass. Water this slope for several days till the plants are about 8 cm tall. Leave the other slope bare.

Dig a channel 7-8 cm wide and 8 cm deep from the base of each slope. Dig another bigger channel (100 cm long, 10 cm wide, and 10 cm deep) perpendicular to these channels and a little away from the bases of the two slopes (see figure). Extend the channels on the two slopes to meet the bigger channel. You may line the bottom of all the channels with small pebbles.

Ask some of the students to pour clear water into the bigger channel which represents a river. Let the other students water the two slopes, one after the other, with a perforated can. Use the same amount of water on each slope.



Ask them to compare the muddiness of the water flowing from the two slopes. Which is more muddy? Why? What is the role of vegetation in reducing soil erosion? What happens to the water of the larger channel when the water from the slopes meets it?

Evaluation

Start a discussion on the origin of rivers. Comparing the results of the activity, let the students discuss how soil erosion on mountains affects river beds and the river flow.

How do river beds get silted up? How does siltation lead to flooding of rivers? How are landslides caused on hilly regions? How can landslides bring about flooding of rivers? Discuss the importance of vegetation in preventing soil erosion.

11 Before We Begin

Farming on sloping land is quite common. But the steep gradient poses many problems. During rains, water flows off the slopes very fast and carries off the fertile topsoil. Some slopes are so steep that cultivation is very difficult.

Without proper techniques, farming on hill sides can have disastrous consequences. To cultivate on slopes, the natural vegetation has to be removed and supplanted by crops. When the crops have been harvested and the land is barren, it is very vulnerable to erosion. Even light rain can cause severe erosion of the topsoil.

By allowing livestock to overgraze slopes, the vegetative cover which holds the soil together and prevents it from being washed away during rains is removed. The worst damage is done by cutting down trees on the slopes.

The disadvantages of a sloping terrain can be overcome by simple techniques. Terracing of the slopes and bunding of the terraces are such techniques. In terracing, the sloping surface is converted into a series of wide, flat steps, one above the other, along the slope. Cultivation is done on the flat surface of each step. Terracing slows down the flow of the water. It breaks up a long slope into a series of short ones, each of which collects and controls the excess water from a definite area of the slope above it. Each of the terraced slopes should empty into grassed waterways to prevent creation of gullies.

The edges of each of the terraces are slightly raised. This is called bunding. Bunding protects the terrace from soil erosion. Bunding can be done by raising the soil at the edges of each terrace with sticks, straw and clay to hold the soil in place.

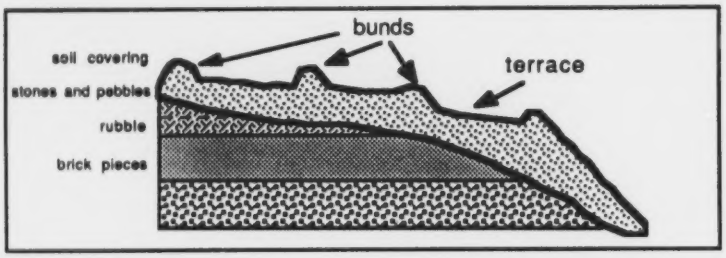
In the following activity the students prepare a terraced slope, bund each of the terraces and grow plants on the slope. They then compare the effect of rainfall on a terraced, bunded slope which has vegetative cover with that on an ordinary barren slope.

Managing the Slope

11

Objective

To demonstrate that terracing and bunding can control soil erosion on hilly regions.



Subject
Social Studies

Place
Outdoors

Group size
Entire class

Duration
Two weeks for preparing the models. 30 minutes for the activity

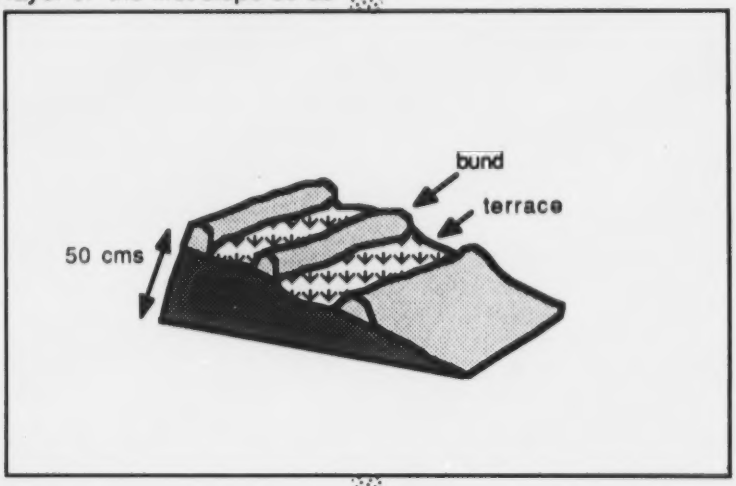
Suitable time/season
When it is not raining.

Materials
Brick, rubble, stones, manured soil, ordinary soil, mustard seeds, one perforated can (1.5 litre capacity), digging implements.

Activity

Let the students prepare two slopes as in the activity 'Wind and Water'. The first slope should be covered with manured soil, the other with ordinary soil.

Now ask them to arrange the soil layer of the first slope so as to form three or four terraces (see figure) . Let them raise the edges of each terrace slightly, to form the bunds.



Let the students grow mustard or grass to a height of 8 cm on the terraced slope. Let the other slope remain bare. From the base of each slope, let the students dig out a channel.

When the slopes are ready, ask the students to pour water over the two slopes with a perforated can and observe what happens to the water flowing from the two slopes.

What is the effect of rainfall on the bare slope and the terraced slope which has vegetation? How do terracing and bunding reduce the extent of soil erosion?

Variation/extention:

The students can visit any cultivated area nearby and observe the different methods of cultivation and soil conservation being practised by the farmers.

12 Before We Begin

More than half of the world's buffaloes and over one-seventh of the cattle and goats are to be found in India which has about one-fortieth of the total land area of the world.

Sufficient fodder for this huge mass of livestock does not exist. To meet the requirements of our own huge population, grazing lands have been ploughed over. Very little attention has been paid to fodder production or conservation of grazing land. As a result, there is not enough grass to meet the requirement of domestic animals which are forced to scrounge for fodder in forests and wastelands.

Inevitably, this leads to overgrazing. Repeated overgrazing in a limited area destroys the regenerative capacity of vegetation. With the removal of the protective vegetative cover the soil is easily damaged by wind and water and precious topsoil is lost.

Also, animals are forced to graze in forested areas. This damages saplings and stunts the growth of trees due to the continuous removal of foliage. Further damage is done with the trampling of tender shoots and the destruction of the roots by hooves of the animals. Overgrazing thus decreases forest cover. With the destruction of vegetation, the natural buffers against floods and drought are weakened.

Interestingly, as grazing lands are reduced, people tend to keep goats which are more hardy and can survive on sparser vegetation. But this only accentuates the damage, as even the sparse and thorny vegetation is destroyed and the land becomes devoid of any vegetative cover.

As the fodder situation worsens, people are forced to migrate to distant areas with their herds, especially in years of drought.

While students may have seen large numbers of animals grazing, they may not have considered the harmful effects of this. The effect of overgrazing on soil is demonstrated in the following activity.

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12

Overgrazing

Subject
Social Studies

Place
Outdoors

Group size
Entire class

Duration
Two weeks preparation time. 30 minutes for the activity

Suitable time/season
When it is not raining

Materials
Brick, rubble, stones, ordinary soil, mustard seeds, one perforated can (1.5 litre capacity).

Objective

To demonstrate the effect of overgrazing on soil.

Activity

Let the students prepare two slopes covered with ordinary soil as in the previous activity. Ask them to sow mustard seeds on the slopes and water them till the plants have grown 8 cm high.

Now ask the students to cut off about 5 cm of the vegetation on the slopes, leaving only the bare stem standing, to simulate the effect of grazing.

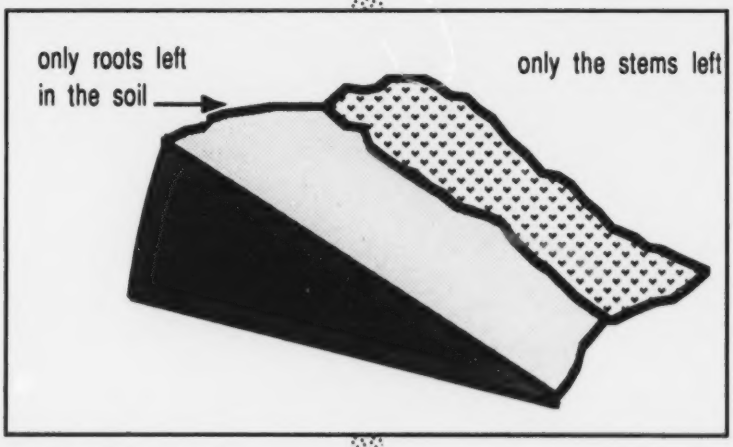
On one of the slopes, let them press into the soil the bare stem and roots, using their fingers to show the effect of trampling by the animals.

Ask them to water the two slopes with the perforated can and observe what happens.

Discuss how loss of topsoil by erosion is brought about by overgrazing and the role of plants in maintaining soil stability.

Evaluation

What happens when too many animals graze on pasture lands? Which domestic animals are most destructive in their grazing and why? What effect does trampling have on the vegetation and the soil?



Variation/extension

Take the students to various overgrazed areas in the neighbourhood and show them the effect of overgrazing on soil. Students can also see the difference between these areas and certain other areas, with vegetation, which are protected from grazing animals.

13 Before We Begin

All land under cultivation needs water. This water can be received either through rainfall or irrigation or both. Where rainfall is adequate the excess salts and minerals contained in the soil are carried downwards to the groundwater and eventually to the sea, rendering the soil free from salinity. This process is called leaching.

However, soils in arid and semi-arid areas, where rainfall has been inadequate or absent, have the problem of a salt build-up. In other areas where soil has naturally restricted drainage caused by slow permeability or low retention powers due to its composition, water logging occurs. After the water evaporates, the soil is encrusted with salt.

All agricultural areas have irrigation facilities, sometimes natural and sometimes man-made. All irrigation waters contain salts, but occasionally the waters are too saline for crop production. When more salt is applied through water and fertilizer than is removed by leaching, the soil becomes saline and unfit for cultivation. Human interference also destabilizes the soil composition, leading to formation of saline soils.

Where cutting down of natural vegetation has caused soil erosion by rain or wind, soil permeability decreases and salt cannot be drained out. In such cases mere irrigation will not help. The land has to be first reclaimed through scientific processes.

Where modern techniques of agriculture have led to excessive use of chemical pesticides and fertilizers, the delicate balance of the soil breaks down, leading to soil salinity, decrease in agricultural productivity or even the turning of the land into an uncultivable wasteland.

Saline soils may be improved by establishing artificial drainage and by subsequent leaching with irrigation water to remove excess soluble salts. Soils can be leached by applying water to the surface and allowing it to pass downward through the root zone. Leaching is most efficient when it is possible to pour water over the entire surface. The amount of water required to leach saline soils depends on the initial salinity level of the soil. If a soil becomes saline and it is not possible to improve it by irrigation, the ability of the soil to hold vegetation, recharge its groundwater or continue as agricultural land is reduced. Droughts due to lack of rain hit these areas very hard.

In the following activity students will be able to observe on a small scale the effect of salinity on the growth of plants.

Soil Salinity

13

Objective

To show how soil salinity affects plant growth.

Activity

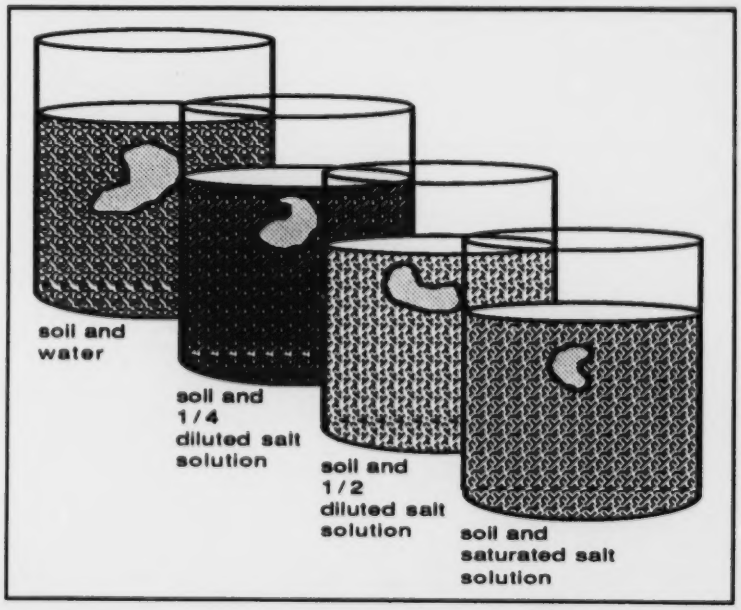
Take four similar tin cans or pots. Let the students fill each of them with soil. Label these as 1, 2, 3 and 4. Plant some bean seeds or gram seeds in each of the four pots.

Take four containers. Label these as 1, 2, 3 and 4.
Let the students take 3.5 litres of water in the first container and mix enough salt in it to prepare a saturated salt solution (i.e., until salt settles down even after shaking the solution well) .

Let them take out 1.5 litres of the saturated solution into the second container and add 1.5 litres of plain water to it. They will now have 3 litres of half-diluted salt solution.

Now let the students measure out one litre of this half-diluted solution into the third container and add one litre of plain water to it. They will now have two litres of quarter-diluted solution. In the fourth container, let them take two litres of plain water.

Let the students use the water in the container 1, 2, 3 and 4 to water the pots 1, 2, 3 and 4 respectively. Let them continue watering the plants as mentioned above for a week or ten days and observe the results on plant growth.



Subject
Science/Social Studies

Place
Classroom/Outdoors

Group size
Entire class

Duration
45 minutes to prepare the activity and then10 minutes everyday for a week.

Suitable time/season
Any time

Materials
Four similar containers (tin cans or pots); soil, 4 containers to hold water (one large container of at least 5 litre capacity and three containers of at least 2 litre capacity each.), salt, bean seeds or gram seeds .

14 Before We Begin

Of the rainfall which reaches the soil surface some enters the soil, some runs off, while some evaporates. The water which runs off may be impounded in lakes and reservoirs or it may reach streams, rivers and finally the ocean. The water which is absorbed by the soil filters underground.

The ability of the soil to accept rainfall and allow the infiltration of water is called soil permeability. This depends on three factors - the composition of the soil, its porosity, and the moisture content of the soil at the time of the rain.

Soil particles are graded in size from sand (the largest) to silt (which is smaller) to clay (which can be powdery when dry). Soil can be of different proportional combinations. The combination determines the ease with which roots, air and water move through the soil. Loam, for example, includes all the three kinds of particles in varying quantities.

All soils have spaces called pores between their grains. The size of the pores varies in different types of soil. This affects the permeability of the soil. The larger the pores, the more permeable the soil. Sandy soils have the largest pores and clayey soils the smallest.

We can study the presence of air in the soil by a very simple process of pouring some water into a container with dry soil. The air in the soil comes out as bubbles, which burst at the surface. When the bubbles stop, you find that the level of water poured in has fallen. This indicates that the water has permeated the soil through the air spaces by displacing the air. The size of the air pockets, and the existence of vegetation in the top soil, which help prevent evaporation, will improve the retention and storage of water. Saturated soil has all its air spaces occupied by water. It cannot absorb any more water. The moisture content of the soil has a greater effect upon the rate of infiltration, than any other factor, during the first twenty minutes of a rain.

The presence of vegetation and humus in the top soil help to regulate the moisture content of the soil. The more deep-rooted the vegetation, the greater will be the permeability of the soil. Where the soil is already saturated, even moderate rainfall cannot be absorbed. Many parts of India are subject to severe rainstorms in a short period. The soil is not covered with vegetation hence, it soon gets saturated and cannot retain the water. This may result in flash floods. Where the soil has been eroded resulting in the formation of hardpan laterite, the permeability of the soil is affected, again resulting in flash floods.

In the following activity the students will be able to compare the infiltration of water through different types of soil.

Soil Permeability

14

Objective:

To demonstrate the influence of soil conditions on water infiltration.

Activity:

Divide the class into four groups. Select four sites in the neighbourhood. The first site can be from an area with thick vegetation or a forested area. The second site can be an agricultural area. The third site can be a built-up area (a school playground or road side). The fourth site can be devoid of any vegetation. (As an alternative, the students can select two sites, one where students congregate and one site where student movement is light or non-existent.).

Mark off study plots, each 2 metres by 2 metres on each site. Let the students observe the natural cover in each study plot. Then ask the students to measure the soil compaction on each site by recording the average depth to which a light iron rod (approx. 1 m long, 3 cm in diameter and pointed at one end) penetrates the soil when dropped several times from a height of 1 to 1.5 m. Next ask the students to record the water infiltration rate on each site. This may be done by taking a 1.5 litre tin can,open at both ends. Place the tin can into the soil (as shown in the figure). Fill it with a known quantity of water and record the time necessary for all the water to penetrate into the soil. Compaction and infiltration measurements should be taken at several locations within each of the study plots.

Students can tabulate the data obtained from the study sites as given below.

Subject
Social Studies

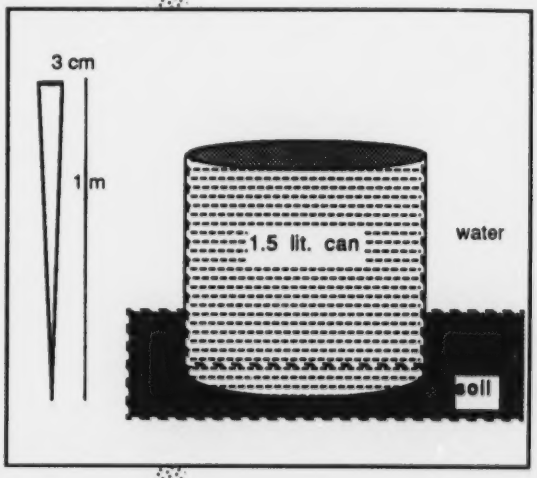
Place
Outdoors

Group size
Entire class

Duration
One hour

Suitable time/season
Any time

Materials
An iron rod (one metre long, and 3-5 cm broad, pointed at one end); 1.5 litre tin can open at both ends.



study site	description of the study site	description of the natural vegetation	depth to which,a one m rod penetrates into the soil	time taken for one lit. of water to penetrate into the soil	soil condition
study site 1					
study site 2					

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Evaluation:

Compare the data obtained from the study sites and discuss:
Why are the soil conditions different in the four study areas?
What effect does the degree of soil compaction appear to have on water infiltration into the soil?
How does soil compaction influence run off?
What is the role of vegetation in increasing water infiltration into the soil?
What is the course of the water that infiltrates through the soil?
Based on the discussions and conclusions, let the students write on ways of minimising the compaction of the soil on the school site, or in the neighbourhood, to increase infiltration of rain water.

Variation/extension:

Ask the students to take three funnels and put some cotton wool in the mouths of each.
Place each funnel on an empty bottle.
They should then put a handful of sand into funnel A, clay into funnel B and loam into funnel C.
Pour half a glass of water into each of the funnels.
After five minutes measure the water that has run into the bottles.
What does this show?

15 Before We Begin

If one looks at a river bank, road cut, or construction site where a section of the soil is exposed, one can often see that the soil is divided into layers. Each soil layer grades into the rock material below. There are about a dozen major types of soil, each with the same basic arrangement of layers.

Layers in the soil are more or less parallel to the surface and differ from one another in one or more properties, such as colour, texture, structure, consistency, porosity and composition. The layers may be thick or thin.They may be prominent or so weak that they can be detected only in the laboratory. The succession of layers (called horizons) is called the soil profile.These develop over a period of time due to weathering, leaching and the decomposition of organic matter. In general, the boundary of soils with the underlying rock or rock material occurs at depths ranging from 30 cm to 2 m.

If we take a vertical cross-section of the soil, we can identify three main layers in it.The topsoil, the subsoil and solid rock.The depth of each layer is highly variable.

The topsoil has more animal life, more humus and greater changes in moisture and temperature than the other layers. The subsoil gets minerals that have been washed downward by rainwater. Clay often collects in this layer. The next layer contains loose and weathered rock and is often the parent material of the soil above. Beneath this we find solid rock that has not been eroded.

A typical soil has, apart from humus, minerals, rock and air spaces between the particles. Water trapped in the air spaces between the particles tends to drain or is held by thick layers underneath. Precipitation or rain infiltrates below the ground surface into the soil zone. When the soil zone becomes saturated with water in one layer (that is, all the air spaces have been filled with water), water percolates downward. Groundwater continues to descend until it encounters solid rock. This groundwater is constantly in motion, though it moves very slowly as compared to surface water. It meanders underground through the rock spaces and forms the water table. The water in the water table is clear water, as can be seen in the wells. The natural filtering process of the soil makes this water potable.

Groundwater too may get polluted though it is less prone to pollution than surface water. It is difficult to detect and rectify such pollution when it occurs. Especially where the soil is sandy, harmful chemicals from industrial effluents percolate into the ground along with the water recharging the aquifers. This pollutes the water and affects people, cattle, crops and wildlife.

In the following activity the students can observe percolation of water through different soil layers and see how it gets filtered in the process.

A Natural Filter

15

Subject
Science/Social Studies

Place
Classroom/Laboratory

Group size
Entire class

Duration
50 minutes

Suitable time/season
Any time

Materials
Large glass jar; gravel (large, broken stones), pebbles, coarse sand, crushed charcoal, fine sand , two containers to hold water.

Objective

To observe the filtering action of the soil by a model.

Activity

Let the students set up a soil filter system using a large glass jar. Fill the jar with 5 cm each of gravel (large broken stones), stones and pebbles, coarse sand, crushed charcoal, and fine sand as shown in the figure.

Let the students prepare some muddy water that also contains some small twigs,leaves etc. Pour the muddy water into the jar.

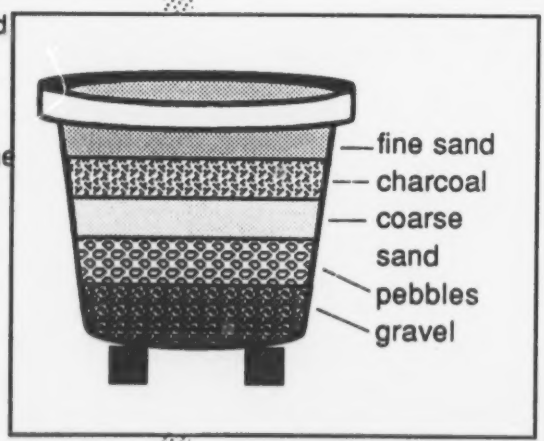
Let the students observe how the water filters through the different layers.

Extension/Variation.

Use a large polythene bag with a small hole punched at the bottom of the bag or use a flower pot.
Prepare the layers following the instructions given above. Pour clean, tap water through the filter to remove any excess materials and to settle the layers.

Place a transparent container below the bag or pot, ready to receive the filtered water. (The mouth of the container should be smaller than the base of the polythene bag, so that the bag is balanced on the container.The flower pot can be placed on two bricks and the container placed beneath.)

Prepare some muddy water that contains small twigs, leaves, etc. Pour some of this water into the bag or pot and collect it in the container at the bottom.



Evaluation

Compare the filtered water to the muddy water. How did the filter trap work? Where did the particles collect?

16 Before We Begin

Much of the freshwater on land is not in rivers and lakes. It is hidden underground in vast reservoirs collectively called groundwater. It is groundwater that supplies water to wells, springs and even to rivers and streams. As groundwater occurs below the surface of the Earth it is difficult to estimate its quantity.

Some of the rain water percolates downward into the ground. This water continues to descend until it encounters solid rock. This water is replenished by infiltration from bodies of surface water which are themselves supplied by rain. The process by which precipitation (rain) replenishes the groundwater supply is known as recharge.

An aquifer is the sub-surface zone that yields important amounts of water to wells. This zone may be porous rock, unconsolidated gravel or fractured rock. This zone may extend for hundreds of kilometres and may be several hundred metres thick. The top of this zone of water is called the water table. Recent estimates have revealed that nearly 70 per cent of India's land mass holds more groundwater than was earlier assumed.

Groundwater has a number of advantages when compared to surface water. Groundwater reservoirs do not suffer seepage losses like surface reservoirs. There is also less loss of water due to evaporation.

The water in aquifers is extracted by man for domestic purposes through wells. Today, one of the most popular ways of using groundwater for domestic as well as irrigation purposes is through tubewells.

If the annual withdrawal from an aquifer regularly exceeds the recharge, the water stored in it will be depleted. This may lead to serious shortages of water for drinking, domestic and irrigation purposes.

The groundwater in the aquifers is a natural reservoir of water. This can be used in times of variable rainfall and during the eight months of the year when most parts of India do not get any rain. Thus it is of primary importance that misuse of groundwater or its over-exploitation is checked.

In the following activity students see how the water which falls as rain percolates through the soil and then rises in the wells.

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Aquifers and Wells

16

Subject
Social Studies

Place
Classroom

Group size
Entire class

Duration
Half and hour preparation time and half an hour for the activity

Suitable time/season
Any time

Materials
An empty aquarium container; clayey soil; stones, pebbles, soil; fine sand; straws; mug or tin; ball pen or marking pen or colour paints

Objective

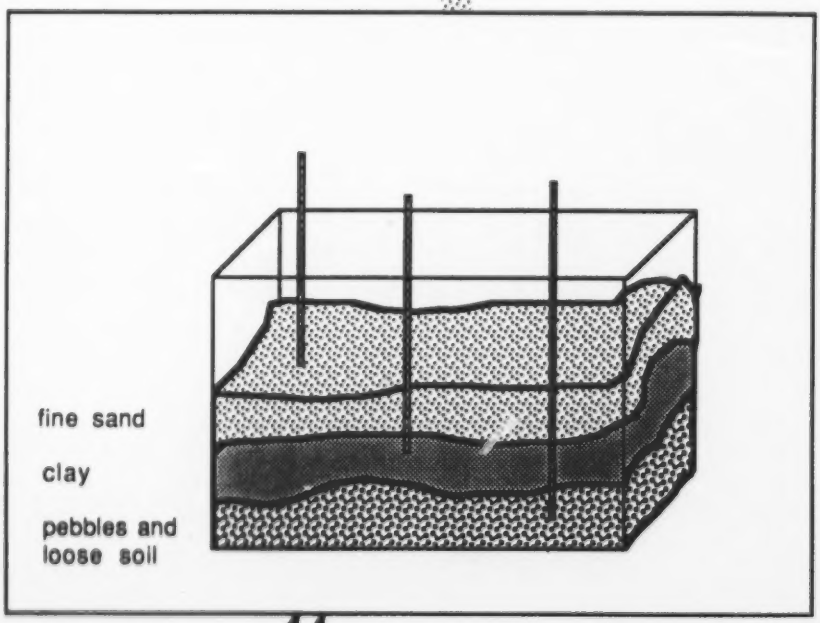
To demonstrate with the help of a model the recharging of wells by groundwater.

Activity

Take an empty aquarium container.
Let the students line the bottom of the container with a 5 cm layer of pebbles, stones and loose soil. Mark the top portion of a few of the drinking straws with one colour and insert them into this layer.

Over this layer, let the students form a 5cm layer of dry and loose clayey soil.
A few straws marked with another colour should be inserted into the layer of clayey soil.
The topmost layer is to be a 5 cm layer of fine sand.
Some more straws marked with a different colour should be put into the sandy layer (see figure).

Tell the students that all the straws represent wells.
Let the students pour water gently, a little at a time, along the walls of the aquarium, without disturbing the soil layers. Let them continue, until the water has percolated through to the bottom layer.
Let them observe the flow of water through the different soil layers.
Let the students find out which of the straws get water first and which last. One way to do this is to put a thin dry stick in each straw and measure the wet part.
How does the water that reaches the stones and pebble layer appear?



Variation/ extension

If an aquarium container is difficult to obtain, any transparent container with a firm base can be used.

Variation in the pattern of layers may be made.

17 Before We Begin

Floods have always posed a threat to human life and property. Their potential for destruction has increased manifold due to our tendency to locate settlements in river plains. Since these plains are fertile, easy to cultivate and near a constant supply of water which can also be used for transport, river plains have always been an attraction to settlers.

To overcome the danger of floods, ancient engineers built earthen mounds along river banks to check the river water. These embankments, built close to the river channel on either side, are called levees. For centuries such levees held Chinese rivers under control and allowed civilization to flourish. Even now levees are used in various parts of the world for this purpose.

But levees have certain disadvantages. If they are set close to the river channel, the river may rise over them quickly and overflow. It may even cut through the embankment or breach it, causing sudden and devastating floods. If it is set too far back, valuable land is wasted. While a levee may confine water to a certain stretch of the river, it may increase flooding upstream or downstream. Levees also prevent silt from being deposited on flood plains. The soil on the river plain gets exhausted very soon without this replenishment. Moreover, the valuable silt carried by the river is either lost to the sea, or gets deposited in the lower reaches of the river, increasing the chances of flooding in these parts.

To avoid these problems, levees are often supplemented by inundation canals which are dug outwards from the river channel. When the river is in spate, the excess water is transferred to these canals. Inundation canals, however, cannot be used for irrigation or navigation purposes as they have water only during the rainy season.

In the following activity, both these flood control techniques are demonstrated in a simple way.

Fighting the Flood

17

Objective

To demonstrate some simple flood control methods.

Activity

Take the students to the playground or near the water taps in the school where there is some ground space that can be used.

Ask them to dig a channel about 1 m long, 15 cm wide and 15 cm deep. Now ask them to pour water into the channel till a stage is reached when the channel is no longer able to hold the water.

Now ask them to make embankments by raising the sides of the channel.

Let them pour water again into the channel until it starts overflowing.

Now ask them to dig some smaller channels - half a metre long, 7 cm wide and 7 cm deep - off the main channel. Let them pour water into the big channel and see how excess water gets diverted into these side channels.

Tell them that these side channels are called inundation canals and they help to control flooding of rivers by diverting excess water to a wider area.

Subject
Social Studies

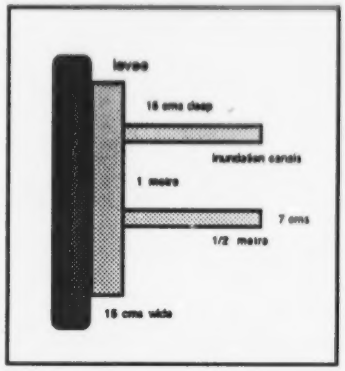
Place
Outdoors

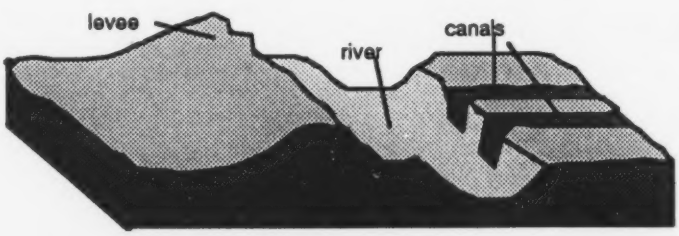
Group size
Entire class

Duration
Half an hour preparation time;
20 minutes for the activity

Suitable time/season
Any time

Materials
Digging implements, buckets, mugs or tins





18 Before We Begin

Wetlands are areas that are at least periodically saturated with or covered by water. This water comes from rain, river floods or the sea. Riverine forests, lakes in which large amounts of sediments have been deposited, estuaries, deltas and mangroves are generally termed wetlands.

Wetlands, especially in flood plains, act as buffer zones during times of flood. At this time enormous quantities of water are temporarily stored in the wetlands of the flood plain and to a lesser extent in flooded soils. Downstream areas, crops and property are thus protected from flood damage. This flood water storage function also helps to slow the velocity of the water. As the flood levels decline, the stored water is slowly released back into the river. The natural flood protection provided by the wetlands along a river is perhaps the least costly solution to flooding.

In addition to reducing the physical damage caused by flood waters, wetlands also help prevent erosion and reduce silting of the river further downstream.

Wetlands help maintain water quality and improve degraded water in several ways: by removing dissolved substances, heavy metals, suspended solids and disease organisms from incoming waters; by processing chemical and organic wastes; by reducing sediment loads of water.

Wetlands are effective water filters because of their location between land and water. They can intercept run off from land before it reaches the water body and help filter plant nutrients and retain them on land. Similarly they also help filter wastes and sediments from flooding waters.

Most wetlands are areas of groundwater recharge and some may even provide sufficient quantities of water for public use. But the recharge potential of wetlands depends on various factors like wetland type, geographic location, season, soil type, water-table location and precipitation.

Most students may not be able to visit a wetland and even if they do so, may be unable to see for themselves the processes of flood control or filtration going on within wetlands. The following activity demonstrates these clearly by building two models, one with a 'wetland' in place and one without it. The students can understand the flood controlling and filtering functions of wetlands by observing these models.

Role of Wetlands

18

Objective

To demonstrate by a model how natural wetland vegetation helps to control floods and to purify water.

Activity

Take two shallow vessels.
Let the students spread a layer of clay so as to cover half the base of each vessel. The clay will represent land. Leave the other half of both the vessels empty to represent a water body.
Let them shape the clay so that it gradually slopes down to the waterbody (see figure).
Take a piece of thick cloth and fold it into four or more layers. Place this cloth at the base of the slope in one of the vessels. The cloth should fit tightly across the width of the vessel. This represents the wetland vegetation buffer between the land and the waterbody.

In the model with the wetland buffer let one student pour some water slowly on the clay (see figure). Let the students observe what happens .
Now repeat the same procedure with the other model, using the same amount of water.
Ask the students to observe what happens and note the differences in the two models.

Now let the students prepare some muddy water. Let them pour some of this water on the clay in the model with the wetland.

Ask them to compare the water that collects at the base of the slope with the water that was poured in.
Let them repeat the procedure in the other model. Ask the students to observe the water at the base of the slope and compare it with the water that was poured in.

Subject
Social Studies

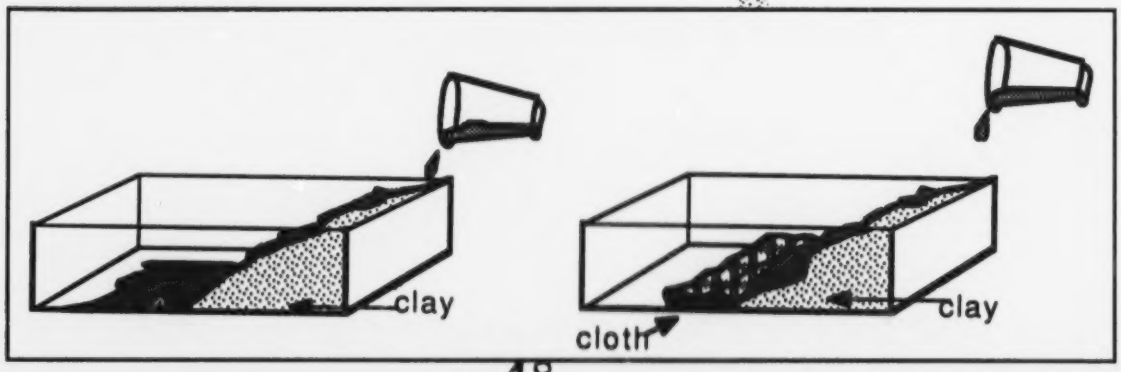
Place
Classroom/Outdoors

Group size
Entire class

Duration
20 minutes preparation time and half an hour for the activity

Suitable time/season
Any time

Materials
Two shallow containers; Clay ; a piece of thick cloth; mugs or tins



19 Before We Begin

Man has made tremendous progress in all fields with the help of science and technology. But this has also meant greater interference with the balance of nature. Land areas have been increasingly mismanaged and over-exploited. This has led to the deterioration of soil.

Agricultural progress has led to the excessive use of chemical pesticides and fertilizers which affect the soil. Use of heavy agricultural machinery, also leads to soil becoming compact thereby decreasing its ability to absorb and retain water.

The growing expansion of industry into agricultural lands has also led to the deterioration of the soil and water in their vicinity. The drainage pattern has been upset. The rain water does not percolate into the soil but drains directly into waterways and increases the chances of flooding. Mining also contributes to soil erosion and causes landslides.

In most areas thoughtless removal of vegetation has led to severe soil erosion by water and wind, causing in turn problems of over-siltation and flooding.

Increasing human settlements have covered much of the land with roads, buildings and other man-made structures. Constructions turn the ground into a solid impenetrable mass, making it impossible for water to seep into the soil. In towns and cities if man-made storm water drains are not planned or maintained, there is every possibility of the rain water causing flooding.

Most of us have the experience of wading through flooded streets after a rainfall. In the following activity students may be encouraged to give some thought to the cause of this flooding and try to trace some of the drainage patterns in their residential or school areas.

Flooded Streets

19

Objective

To observe and comment on the effect of heavy rains on human settlements.

Activity

Before it rains, the students, in small groups, should take a walk in their residential areas.
They should make a sketch of their residential areas showing houses, streets, etc. The sketch need not be to scale. A sample is given below.

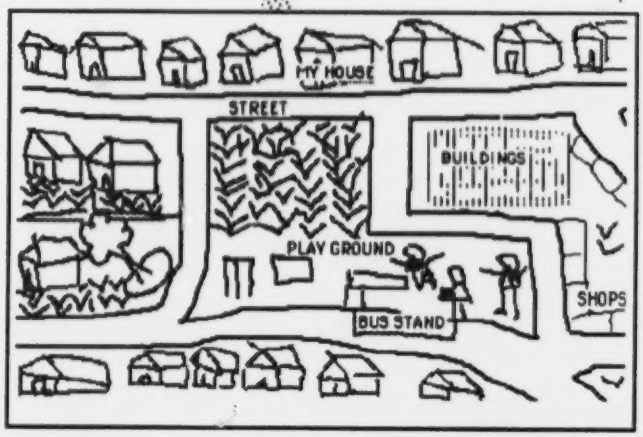
They should observe the different types of roads and paths in their area. (A tar road, a gravel or stone road, and an earthen road.)
The students should be asked to observe whether the drains are clean and well maintained or filled with litter.

After the rain - preferably a heavy rain - the students should take another walk, in the same area of which they have prepared the sketch. They should observe the way the rain water flows away from the houses and the roads into the drains.

Are the roads flooded after the rains? If so, why?
The following questions may be given to them as clues to what to look for.

- Does the rainwater form puddles? Where?
- Where does the rainwater collect? At the sides of the roads, in the middle of the road?
- Does the rainwater drain into ditches?
- If the area is well-drained, how long does the water take to get absorbed by the soil or to drain off?
- If the soil is built over and the drainage system is not good, for how long is the area flooded?
- How deep is the water in the flooded areas? (This can be seen by dipping a stick and the wet part being measured with a ruler.)
- If the soil is covered by vegetation, does it make any difference in the flooding?
- How do the people, animals and vehicles pass through the areas filled with water?

Each student or group should be asked to submit a short report on their findings.



Subject
Social Studies

Place
Anywhere

Group size
3-6

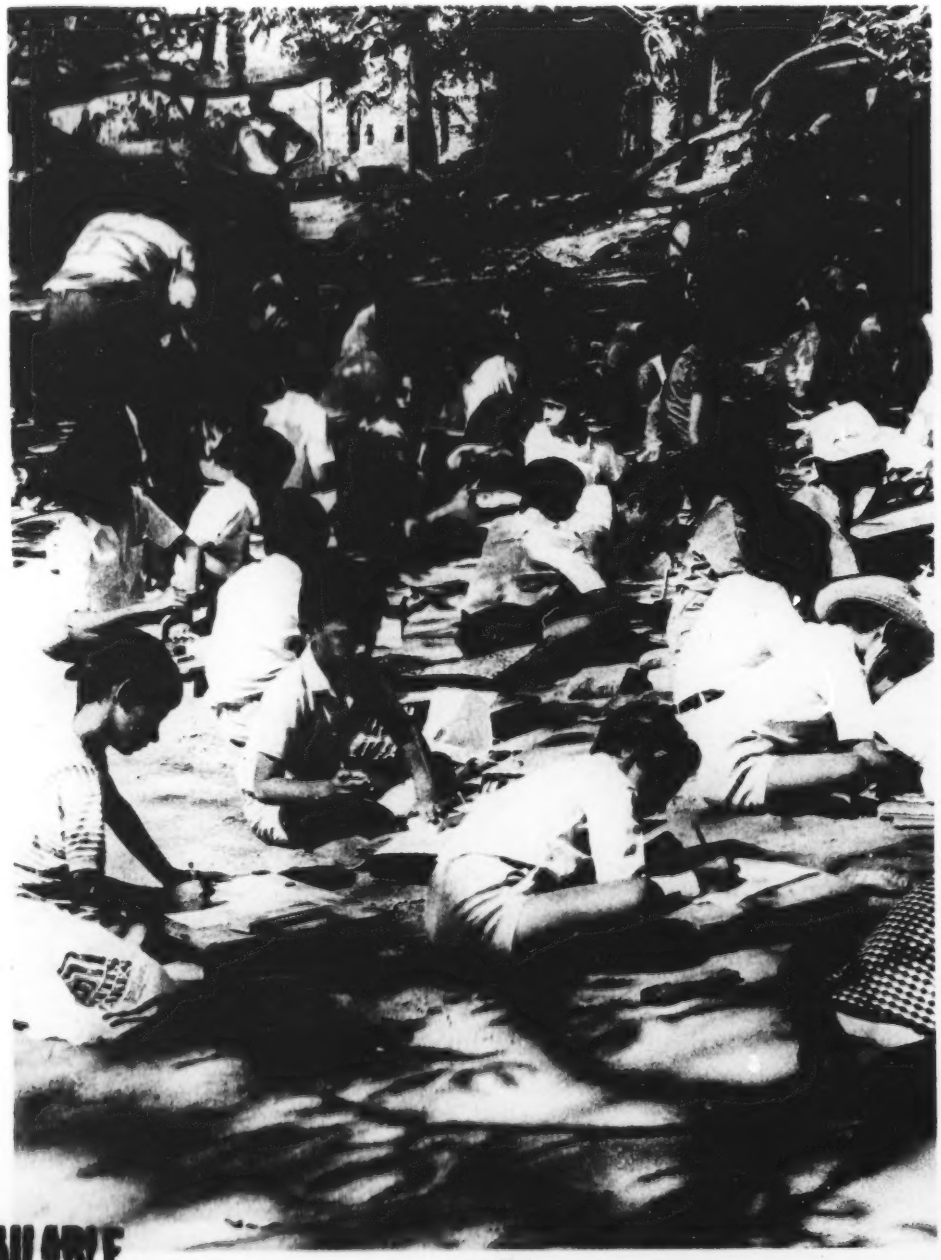
Duration
Two sessions of 45 minute duration

Suitable time/season
Rainy season

Materials
A stick or ruler; paper, pencil and pen; colour pencils, crayons

20 Before We Begin

Rain is a popular subject for poems, and composing picture poetry is fun for children. The words in a picture poem are written to form a picture of what the poem is about. The lines in the poem may rhyme if the students want to, but this is not absolutely necessary. Also, the lines do not have to be of equal lengths, and punctuation is not necessary. The children just have to form a picture with the words they write.



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Picture Poetry

20

Subject
Language

Place
Classroom/Home

Group size
Individual, 3 -4

Duration
30 minutes

Suitable time/season
Any time

Material
Colour pens, pencils, crayons

Objective

To introduce students to a creative way of expressing ideas through words formed as pictures.

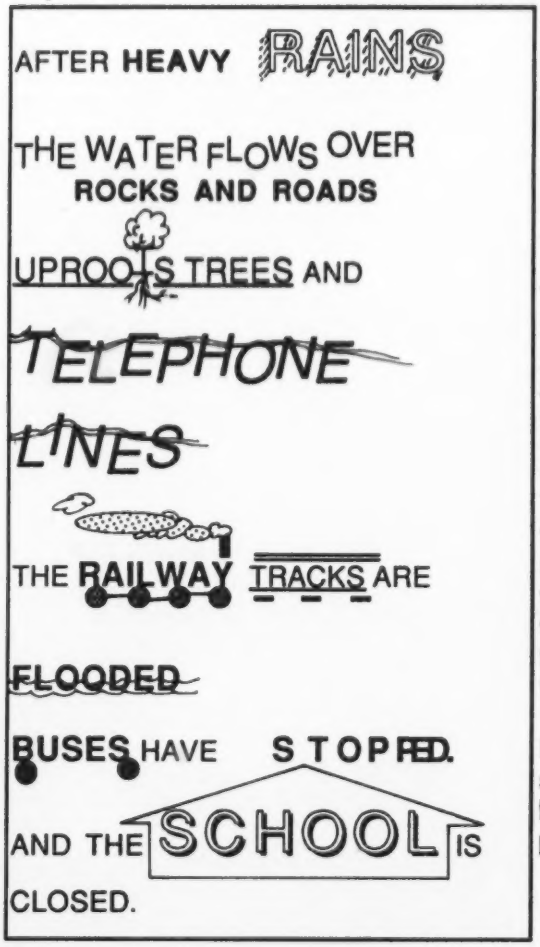
Activity

Before starting, copy the picture poem given onto a blackboard, chart or any other display device.

Then ask the students if they can think of words about rain, causes of rain, floods or drought. List the words they come up with on the blackboard.

The list must include ideas on the water cycle, impact of rain on men, animals, plants, soil, agriculture, roads, trains, houses, water supply, milk, newspapers, etc.

Explain that words can also be written so that they form a picture right on the page itself. Point to the picture poems you have copied.



Ask the students if the poem would be as much fun to read if it were just written across the page instead of in the form of a picture. Talk about some words like bus, school, and tree which can be written in a way that describes their meaning.

Now have the students make their own picture poems.